Waste Reduction -
Metal Fabrication Fluids and Wastewaters

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by
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INTRODUCTION

Waste reduction is the most efficient and cost effective way to solve the environmental problems of industry. There are many reasons to do waste reduction. The best is it saves money! Waste reduction is not usually high-tech or real complicated. The best waste reduction program is a team effort with all employees doing their part. It can be adapted to your company's needs and culture. There are many resources available to help you get started and succeed.

The metal fabrication industry needs technical assistance in this area. EPA CERI in Cincinnati, Ohio, awarded an Interagency Agreement to TVA to develop training manuals and workshops to help this industry apply current waste reduction techniques.

TVA is partnering with the Waste Reduction And Technology Transfer Foundation (WRATT) and the Institute of Advanced Manufacturing Sciences (IAMS) to deliver this training. IAMS wrote the manuals with input from many companies and other organizations. WRATT is coordinating scheduling and delivery of the workshops. Partners and cosponsors for workshops are being used to ensure industries are reached. Five workshops were completed in 1996 in locations ranging from Miami, Florida, to Detroit, Michigan, and the remainder are being scheduled for 1997.

The training focuses on effective application of proven waste reduction processes for metal fabrication companies. The two waste types are metal fabrication fluids (coolants and lubricants) and wastewaters. Plating and coating wastes have been well covered elsewhere and coverage will be limited, possibly tables listing options and references. The primary audience selected are small to medium-sized companies with less than 200 employees. The metal fabrication processes covered include: broaching, turning, milling, threading, and tapping.

WASTEWATER AND WASTE REDUCTION

Wastewater P2 can be very cost-effective. Based on 15 cases studied in California, which covered several industries (electronics manufacturing, metal finishing, paper reprocessing, and food processing), the water savings were 20 to 40 percent (2 to 470 million gallons per year). The average cost savings were $150,000 per year with capital pay-back periods ranging from 2 months to 3 years with most less than 1 year.

Common sources of wastewater include the following:
- Aqueous cleaning of parts or equipment
- Water-based coolants
- Cooling water
- De-burring and mass finishing
- Boiler blow-down
- Wastewater from cutting and blasting
- Wastewater from air pollution control such as scrubbers

As with all waste reduction you must be open to new ideas and evaluate various options. There are no “magic bullets” which will solve every situation cost-effectively. The first step is to determine which processes are generating wastewater and the quantity and quality of each stream. You can not evaluate options if you do not know what you are generating. Track water use and wastewater generation over time, including nights and weekends and outage periods. PROPER SAMPLING & ANALYSIS ARE ESSENTIAL. Most people don’t understand importance and difficulty of representative sampling. Bad data about wastewater streams results in bad P2 decisions.

Waste segregation is very important for pollution prevention. It is more difficult to find beneficial uses for mixtures. Also, small concentrated streams are easier to manage than large dilute streams and streams with few contaminants are easier to treat than complex mixtures.

There are several basic P2 measures for wastewater which do not involve any significant equipment or process redesign. First ask if you can eliminate the process (do the parts really need cleaned?). Then ask if you can eliminate the use of water in the process. Can you reduce the use of water in the process? Finally can you reuse the water in another process, with or without treatment? Examples include:
- Turn valves down or off (automatic controllers instead of manual)
- Preventative maintenance, i.e. stop leaks (pumps, seals, piping)
- Change to dry clean up methods (use a broom not a hose)
- Reuse water as is without treatment for a less stringent process
- Ensure proper mixing of chemicals

The next level is to evaluate P2 measures that are more complex. Examples are: substitution of less toxic raw materials, training operators to ensure proper and consistent methods are used; optimizing your processes; installing closed-loop systems; treating a wastewater to allow reuse; and exchanging wastes with other industries.

Other P2 measures which are usually cost-effective include:
- using de-mineralized water for makeup for: metal working fluids, plating baths & rinses, or parts
- using cleaning rinses

- reuse of cooling tower blowdown
- recovery of metals from plating baths & rinses
- reducing oily waste from aqueous cleaners

Cleaning

Cleaning is a process which often generates wastewater in the metal fabrication industries. Selection of the best cleaning process addresses the surface being cleaned, the soil to be removed from the surface, and the required level of cleanliness. The amounts of wastewater generated may be minimized by: (1) avoiding the need for cleaning, (2) maximizing the efficiency of the existing cleaning systems, and (3) using the least hazardous media. Some alternatives which will avoid or reduce the need for cleaning include: indoor storage, just-in-time delivery, using shrink wrap to protect parts, and improving coating efficiency. The latter will reduce rejects and the related need to strip and clean parts.

Some source reduction options for cleaning wastewater include:

- changing to non-detergent cleaning solutions, i.e. using hot water and/or high pressure,
- extending solution life by on-line filtration or other means,
- minimizing losses,
- reducing drag-out or carryover from one process tank to the next,
- making pre-cleaning inspections so you don't clean unnecessarily,
- proper makeup and mixing to ensure proper concentrations, and
- periodically monitor concentrations and bring them back to recommended levels.

Drag-out or carryover can be reduced by many methods which keep more of each solution in its respective tank or container. Some options include the following:

- using less concentrated solutions which reduces the contaminant load in each drop and may also reduce viscosity,
- increasing drip times over the originating tank (a total of 10 to 30 seconds is usually adequate),
- using drip boards to direct drainage back into the originating tank,
- positioning the work-piece on rack to maximize drainage and minimize the volume of solution cupped within the piece,
- increasing solution temperatures or adding wetting agents to reduce viscosity and speed drainage,
- using air knives to blow drainage back into the originating tank, or
- using drag-out tanks (dead or static rinse tanks).

Proper work-piece positioning depends on the shape of the part and the rack or conveying mechanism. The best position will: tilt each piece so drainage is consolidated; avoid, if possible, positioning parts directly over one another; tip parts to avoid large flat surfaces or pockets; and position parts so only a small surface area comes in contact with the solution surface as it is removed from the solution.

Common pollution prevention measures for rinse-waters often involve relatively minor piping or equipment changes. Examples are: counter-flow rinsing, still rinses, flow and/or conductivity controls, spray or fog rinses, and agitating rinses to improve cleaning.

Wastewater Treatment

Treatment should be evaluated if the wastewater can not be eliminated at the source. Treatment processes should be optimized to ensure the most cost-effective treatment of any remaining wastewater. Concentrated brines or sludges should be evaluated to determine if their metal content can be recovered cost-effectively. The water content of all sludge should be reduced to the maximum extent practicable using filter presses or dryers. This will reduce paying for shipping and disposal of water.

METALWORKING FLUIDS

Metalworking fluids are used to facilitate the cutting operation by one or more of the following: lubrication, cooling, cleaning out chips, and inhibiting corrosion. The common waste fluids and lubricants in the metal fabrication industry include:

- Non-dilutable straight oils
- Water soluble oils
- Semi-synthetic fluids
- Synthetic Fluids

These range from 100 percent petroleum oil in the concentrate to zero.

Fluid management can have tremendous impact on metalworking costs and productivity. The primary aim should be to extend the useful life of fluids through source reduction, reuse, and recycling. This will improve product quality, reduce purchases of new fluids, decrease disposal of spent fluids, reduce downtime for machine clean-outs, and improve working conditions for the operator.

Price should **never** be the primary criteria for choosing metalworking fluids. Many other factors such as: part & machine requirements, fluid life, treatability, disposal costs, microbial resistance, and corrosion protection. If possible standardize on as few fluids as practicable based on the issues above. This will simplify operations, minimize contamination, enhance recycling, and allow volume price reductions.

Waste Reduction for Metalworking Fluids

The fluids must be routinely checked for such things as: water level, tramp oil, fluid concentration, biological growth, dirt, rust, foam, filterability, and surface tension. Where practical checks should be made with a test method not some type of operator observation so the results will be more consistent and reproducible from operator to operator.

Control concentrations for optimum performance and life. Many people seem to assume that a more concentrated solution delivers better performance, but in fact, performance often decreases.

The most common cause of fluid degradation is bacterial contamination. It is essential that sumps and machines be cleaned according to manufacturers recommendations on a regular basis. If practical, the sumps should be disinfected.

Use demineralized water to blend synthetic coolants and lubricants. High mineral content often causes stability problems with soluble oils and semi-synthetic fluids. These minerals will also build up over time and result in changes in fluid alkalinity. Therefore, demineralized water will increase performance and extend fluid life. Maintain gaskets, wipers, and seals. These are essential in keeping contaminants, such as tramp oil, out of the metalworking fluid.

Standardize fluids to enhance treatment and reuse options. This will usually also allow for some economy of scale in purchasing new fluids. Keep metalworking fluids clean! Install screens or covers to keep trash out of the fluid in the sump. Also evaluate use of ultrafiltration or skimming equipment to remove contaminants before they can further degrade the metalworking fluid.

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